U.S. ATLAS PROJECT OFFICE

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May 29, 2001

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SUBJECT: U.S. ATLAS Physics and Computing Project Quarterly Status Report for Q1 2001

Dear Sirs:

Attached please find Quarterly Status Report 1 for the U.S. ATLAS Physics and Computing Project.

Sincerely yours,

John Huth
U.S. ATLAS Associate Project Manager

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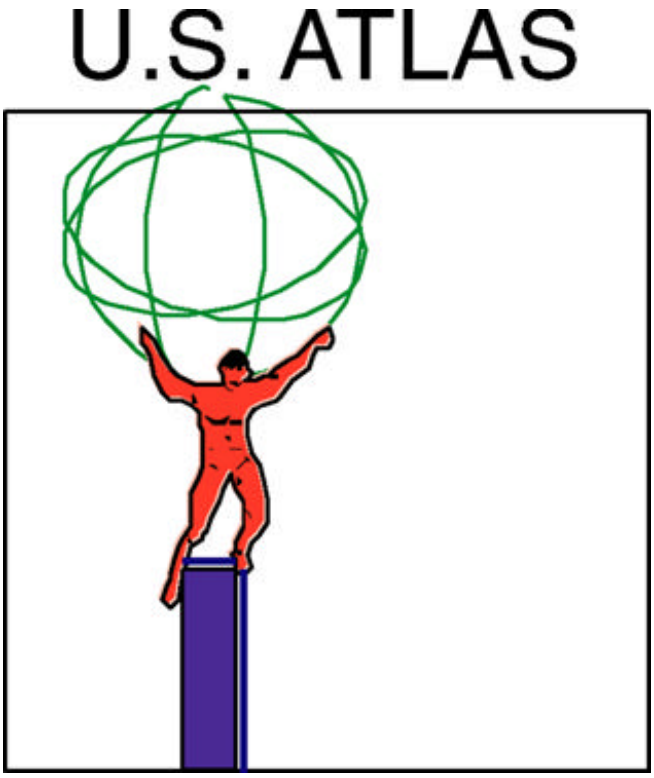

COMPUTING AND PHYSICS PROJECT STATUS REPORT NO. 2

REPORTING PERIOD

Q1 2001

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1. Project Objective

The U.S. ATLAS Project consists of the activities to design, supply, install and commission the U.S. portion of the ATLAS detector. The detector will become part of the Large Hadron Collider (LHC) at CERN, the European Laboratory for Particle Physics. The ATLAS detector is being designed to understand the dynamics of electroweak symmetry breaking. The U.S. ATLAS collaboration is funded jointly by the U.S. Department of Energy and the National Science Foundation.

The fundamental unanswered problem of elementary particle physics relates to the understanding of the mechanism that generates the masses of the W and Z gauge bosons and of quarks and leptons. To attack this problem, one requires an experiment that can produce a large rate of particle collisions of very high energy. The LHC will collide protons against protons every 25 ns with a center-of-mass energy of 14 TeV and a design luminosity of 10^{34} cm^{-2} s^{-1}. It will probably require a few years after turn-on to reach the full design luminosity.

The detector will have to be capable of reconstructing the interesting final states. It must be designed to fully utilize the high luminosity so that detailed studies of rare phenomena can be carried out. While the primary goal of the experiment is to determine the mechanism of electroweak symmetry breaking via the detection of Higgs bosons, supersymmetric particles or structure in the WW scattering amplitude, the new energy regime will also offer the opportunity to probe for quark substructure or discover new exotic particles. The detector must be sufficiently versatile to detect and identify the final state products of these processes. In particular, it must be capable of reconstructing the momenta and directions of quarks (hadronic jets, tagged by their flavors where possible), electrons, muons, taus, and photons, and be sensitive to energy carried off by weakly interacting particles such as neutrinos that cannot be directly detected. The ATLAS detector will have all of these capabilities.

The ATLAS detector is expected to operate for twenty or more years at the CERN LHC, observing collisions of protons, and recording more than 10^7 events per year. The critical objectives to achieve these goals are:

- Excellent photon and electron identification capability, as well as energy and directional resolution.
- Efficient charged particle track reconstruction and good momentum resolution.
- Excellent muon identification capability and momentum resolution.
- Well-understood trigger system to go from 1 GHz raw interaction rate to ~100 Hz readout rate without loss of interesting signals.
- Hermetic calorimetry coverage to allow accurate measurement of direction and magnitude of energy flow, and excellent reconstruction of missing transverse momentum.
- Efficient tagging of b-decays and b-jets.

2. Project Manager's Summary

Funding for the second half of FY 01 was distributed to the ANL, BNL and LBNL as part of their fin plans. Based on feedback from previous reviews, the data management effort at ANL was strengthened by the addition of approximately 3.5 FTE's, and now data management efforts are proceeding at a reasonable pace. Because the funding plan did not materialize at the desired level, cutbacks in a number of areas were necessary. The hire of a software professional to help with the event generator interface had to be deferred into FY 02, resulting in cutbacks in the deliverables in this area. Support in this area is unstable, and can threaten milestones for forthcoming mock data challenges.

Another area where support levels were reduced compared to the plan was in the facilities area. The primary emphasis on core software development, as opposed to increases in facilities or physics was considered necessary due to the criticality of the availability of a control/framework and data management infrastructure for the collaboration. These are necessary prerequisites for developers and users. The cutback in facility growth has significantly delayed a number of hires to augment the currently stressed staff, and also has delayed the acquisition of a significant amount of hard storage media. The present focus in the facilities subproject is maintaining an acceptable level of U.S. user support. Under the present budget guidance, the facility plan is delayed approximately one year from the schedule discussed in the November 00 review.

Two prototype Tier 2 sites were selected, based on a competitive review process run by the Facilities Managers. These are Indiana University and Boston University, both of whom are participants in the iVDGL proposal to fund prototype Tier 2 centers. Rob Gardner is leading an effort to establish a U.S. ATLAS testbed, and various grid tools are being deployed at these sites.

Core software efforts, mainly data management and the control/framework are proceeding roughly on schedule. A major "floating" milestone that had not been updated since the 1996 Computing Report is the selection of the database product. Current contenders are ROOT, Objectivity and Oracle 9i. There has not been sufficient time to do a serious comparative evaluation of these products. Consequently, the anticipated milestone of a June 01 selection of a database product has been shifted back approximately one year. This has been accepted by the collaboration. Much of the slippage is due to the lack of manpower over the past year. This slippage is not believed to have a serious impact in other areas, however. Part of the reason for this is that there is a relatively lightweight interface between the control/framework and the database product, allowing a relatively painless substitution of alternative products.

A substantial amount of time was devoted by project management to craft an overall grid workplan. The major challenge here is the interface with a large number of grid related projects, which derive funding from a number of independent sources. It is important to have a synchronization of the release of grid tools with facility deployment and the development of ATLAS software, and this planning takes a considerable amount of time. It is hoped that this plan, now developed, will help give important feedback to the grid related projects and help to define a toolkit release schedule.

Based on recommendations of the November 00 computing review, principals in U.S. ATLAS and U.S. CMS met at CERN in January 01 to discuss possible collaboration on a number of common projects with the aim of increasing efficiency. Arising from these discussions was a number of areas of commonality that has ongoing collaboration:

- In data management, a coordinated, CERN based evaluation of the database product Oracle 9i is being formed.

- Joint meetings between U.S. ATLAS and U.S. CMS facilities managers are being held to exchange information on hardware acquisitions with the aim of reducing duplication of effort in product evaluation and deployment.

- Common sharing of some grid tools is in progress (GDNP, for example).

- Other areas of sharing were discussed, but these were more tentative.

3. WBS 2.1 Physics Manger's Report (Ian Hinchliffe, LBNL)

Some of the primary goals of the Physics Subproject include the support of event generator and their interface to the ATLAS framework (WBS 2.1.1). In September 2001, a physics workshop is scheduled to be held in Lund, Sweden. For this workshop, a release of the Athena framework is scheduled which incorporates the main physics event generators, and the Atlfast detector simulation package, which features a fast simulation of the detector.

Scheduled deliverables associated with the release of the new fast simulation code were made. Two physics generators are fully supported (Pythia and Isajet). Herwig support is available but not advertised as it is for an old version and lacks any documentation or thorough testing. Note however, that the Physics Manager for U.S. ATLAS is the only person to deal with any problems that might arise when they are actually used.

Work on interfaces for other more specialized generators has not started and will not start until after the Lund meeting in September. This means that users who want these (most desired are tauola and vecbos) are without support for the indefinite future.

Code has been written (by Maria Smizarska) to access the generator information (GENZ) from the old TDR tapes and access it inside Athena. There is a need to spend some time checking/integrating this, and is overdue.

The Generator support role is now too big for the Physics Manager to continue alone given his other responsibilities particularly when we start the run-up to the mock data If the project support projected for FY 02 and 03 for an additional hire does not materialize, this support will have to be reevaluated.

Summary of Major Milestones and Deliverables:

Forthcoming Milestones:

WBS 2.1.1

(29 June 01) Library of generators available. Isajet and Pythia are likely to be supported, whereas Herwig, StdHep, Tauola and Vecbos are likely to not be available in this release of Athena. The major issue in the late generators is the lack of support for the Physics Manager.

4. WBS 2.2 Software Manger's Report (Torre Wenaus, BNL)

WBS 2.2.1.1, 2.2.1.2, 2.2.1.4 Framework, Architecture and Event Model

This reporting period began with a major milestone and set of framework deliverables. This was the so-called "December 2000 Milestone", which actually was declared to be the date of the first ATLAS release following the nominal date of 29 December 2000. This corresponded to ATLAS release 1.3.0, which was finally announced on 29 January 2001 after a protracted build process.

Major deliverables for this milestone were:

- Deployment of the StoreGate event data access model. Although some functionality was still missing, this made it available to general ATLAS developers.

- Deployment of interactive scripting using the Python scripting language.

- A strategy for the so-called data dictionary was in place.

Other achievements and activities during this reporting period were:

- A first version of the Athena Users Guide was written, initially based on release 1.3.0. This is in the process of being expanded into a Users Guide, a Developers Guide and a Tutorial, incorporating common sections from the Gaudi Developers Guide Gaudi is the LHCb Framework upon which Athena is based.

- ATLAS and LHCb now share a common code base and repository for GAUDI and thence Athena. Used from ATLAS release 1.3.2 with minor ATLAS-specific fixes still to be merged back.

- Support for both Solaris and Linux using gcc 2.95.2 was added but was incomplete at the end of the reporting period.

- The ability to filter events into different output streams was added to the framework, meeting a requirement from the Event Filter.

- The setup scripts were modified to use ATLAS standard environment setup scripts, thus easing use at remote sites.

- Limited control support was added when Python scripting is in use.

- Significant progress was made towards restructuring the service management to provide a more flexible configuration environment. However, this work was incomplete at the end of the reporting period.

- An Architecture Workshop was organized at CERN on 23 Jan 2001. The primary goals were to report briefly on the status of the Athena framework, to get feedback from users and developers, and to refine the plans for future milestones and deliverables based on that feedback and any changes in priorities that might arise.

- The final meeting of the ATLAS Architecture Review Committee (ARC) took place on 5-7 March 2001. We still await the final report.

WBS 2.2.1.3 Databases and Data Management

A major database accomplishment in this quarter was the introduction in ATLAS software release 1.3.0 of database support for Athena. The principal component of this support is what the Gaudi/Athena framework calls a conversion service, which handles mappings between transient data (as seen by physics programs) and persistent representations (as stored in databases). A conversion service that supports the ATLAS baseline database technology, Objectivity/DB, was introduced by the ANL database group. Standard Athena tutorial examples, used to illustrate how an algorithm might write data for reading by downstream algorithms, were demonstrated to run successfully, unmodified, with the data stored in and subsequently retrieved from an object database.

Persistence capabilities were provided in support of collections of events in HepMC format, the common format used by ATLAS and other experiments to represent the output of physics generators such as ISAJET and PYTHIA. Persistence for the Athena-based version of Atlfast, the principal ATLAS fast simulation program, was also demonstrated. At the request of the Architecture Review Committee, this persistence was implemented, without optimization, in two technologies -- Objectivity/DB by ANL, and ROOT 'blobs' by LBNL and ANL -- to demonstrate the ability of the core software to maintain independence of database supplier.

A ROOT-based persistency service was developed at Nevis and BNL to provide Geant4 simulation persistency and Athena-based access to Geant4 data needed by the liquid argon efforts at those sites. The service is based on the I/O system of the STAR experiment. The work is expected to develop into a role in the ATLAS evaluation of ROOT-based persistency.

The freeware relational database MySQL has been employed in the liquid argon community for certain run bookkeeping and storage of testbeam calibration data, accessible within Athena via a technology-independent API. BNL has developed database software in support of these applications, and has done so in a way intended to make the software viable as a generalized

service accessible through the Athena framework. This work is being integrated into the overall database effort, and ANL has begun support of MySQL as a recognized external package for ATLAS.

Significant time was spent on interaction with the Architecture Review Committee, whose final meeting prior to writing the closeout report was held on 5-7 March. The committee took particular interest in plans for database technology evaluation, which will largely be done in a 2002 timescale. The review process served as a catalyst for a decision by the database coordinators to produce a database architecture document, since the ATLAS data-handling model, apart from resource estimates for the Hoffmann review, had not been revisited since the Computing Technical Proposal was written. A draft is tentatively scheduled to be available before the end of the next quarter.

Database plans and milestones for the next quarter include enhancements to the Objectivity persistence service to support Gaudi interobject references. The Gaudi interobject reference support will eventually be replaced as the StoreGate software (which will be the interface between ATLAS algorithms and the transient data stores) develops its own interobject reference architecture.

Support for output collection registration will be introduced in the next quarter, with an aim to connect this work to ATLAS bookkeeping work underway in Grenoble, and to emerging grid replica catalog services, before the end of the year. Rudimentary persistence will be provided for data in the transient detector data service, which, in the Gaudi/Athena architecture, houses time-varying conditions information and other detector data. More complete persistence connections between Athena and detector data will be provided once the ATLAS detector description architecture has been articulated. Transaction management sufficient to support access to different stores for conditions and event data will be introduced; this will be a joint ANL/Orsay effort. Elementary support for physical clustering within the database will be introduced as well.

The ATLAS database software must make a transition to a new version of the Objectivity/DB object database product in the coming months. This work will be a joint US/European effort. ATLAS schema management and database build infrastructure will need serious attention in the coming quarter. While this effort will be led by Orsay, it will necessarily include some US database effort.

WBS 2.2.1.10 Distributed Data Management and Processing Software

A detailed program of software development and scheduled deliverables in distributed data management and processing software was developed for the Particle Physics Data Grid project, based on delivering useful distributed processing capability to ATLAS and US ATLAS. This program was adopted as an outline for the PPDG program in general in the new PPDG SciDAC proposal that was submitted during this quarter.

A prototype distributed data cataloguing system 'DBYA' based on the MySQL relational database was developed for use both as an operational catalog for ATLAS data and as a testbed for distributed data and metadata management studies and technology evaluations. The system

was populated with ATLAS simulation and test beam data sets in mass store and on disk at CERN and the BNL Tier 1 center.

WBS 2.2.2 Simulation and Reconstruction Software

Core software efforts continued to be complemented by much (primarily off-project) development activity in subsystem software. Work continued in all areas described in the last quarterly report. The U.S. acquired a new major subsystem software role in International ATLAS when Pavel Nevski (BNL) was asked to serve as the ATLAS DICE/Geant3 coordinator for two years, with responsibility to coordinate Geant3 based simulation development and production. The Geant3 based simulation will be the production simulation for the coming Data Challenges DC0 and DC1. Pavel was officially named to this role after the end of the reporting period.

WBS 2.2.4 Software Support and QA/QC

The software support and librarian effort took on additional responsibilities during the quarter in the development of improved software test and validation tools. Development was initiated on a facility which will produce nightly builds of ATLAS software based on the most recent tagged versions of package, and will provide immediate feedback to developers on newly introduced software bugs and incompatibilities. This system is expected to help ameliorate the present ATLAS difficulties in assembling functional software releases in a timely way.

In collaboration with the ATLAS quality control group, BNL took the lead role in assembling and editing a new revision of the ATLAS Coding Standards document. The new revision was released and favorably received during the quarter.

A new U.S.-based CVS repository was established at BNL for the use of the U.S. ATLAS community. It is used for software development projects too preliminary for the ATLAS repository; for projects with a local scope; and for the personal CVS repositories of U.S. collaborators. Browse and search tools were provided.

The HyperNews web-based discussion tool was fully deployed as the host of a number of discussion forums on US LHC common projects, remote use of ATLAS software, etc., as well as local US mirrors of the most important CERN-based email lists.

WBS 2.2.5, 2.2.3 Training and Collaborative Tools

A new cycle of training courses was launched, with a solicitation sent to gather interest in a proposed set of courses in languages and ATLAS software tools. A successful Geant4 course was conducted at University of Michigan in February with about 16 attendees. The course was accompanied by careful arrangements to record it using the Michigan- developed Syncomat web-based lecture tool. The result is a high quality web based version of the lectures that should be made public in the next quarter and should be useful throughout ATLAS.

Project Management Tools

Following a set of requirements agreed with International ATLAS in December, the U.S.-developed XProject project planning software was extended to support its use by International ATLAS (and potentially other ATLAS national bodies) for the project WBS and schedule. It will form the basis of unified project planning between U.S. and International ATLAS. The U.S. and ATLAS WBS's were implemented as distinct 'projections' out of the same WBS sources, coinciding wherever possible but differing where necessary. The XProject-based schedule was synchronized with that of International ATLAS for adoption by the latter as the schedule for planning purposes. At the end of the period the XProject system was nearly ready to release to

International ATLAS

Work was also initiated to extend XProject to support Grid Computing planning, following interest expressed at the January ATLAS Grid meeting.

In software agreements, the draft agreement on Framework and Data Dictionary stood as complete from a U.S. perspective and was under review by International ATLAS throughout the period. The first subsystem-level exercise in software expressions of interest was completed in the liquid argon community, with the U.S. submitting a coordinated response covering U.S. interest in LAr software.

The effort required to deal with the fragmented and tentative funding sources and options promulgated by the agencies continued to consume substantial amounts of time and effort, deflecting work from software development and other project activities.

Summary of Major Milestones and Deliverables

WBS 2.2.1.2
(9 Jan 2001)'December 2000' Athena release announced

WBS 2.2.1.4
(29 Jan 2001) 'StoreGate' event model released

WBS 2.2.1.3
(29 Jan 2001) Database support for Athena introduced

WBS 2.2.4
(30 Jan 2001) C++ Coding Standards released

WBS 2.2.1.1
(5 Mar 2001) Final meeting of Arch Review Committee

WBS 2.2.1.10
(15 Mar 2001) PPDG software development plan established

Forthcoming Milestones and Deliverables

The next major milestone will be the Athena Gamma release in May. Deliverables with substantial U.S. involvement are indicated.

WBS 2.2.1.2

May ATLAS software release: Athena gamma release
- Objectivity event I/O fully deployed (WBS 2.2.1.3)
- Data dictionary prototype
- Pile-up support prototype
- Physics analysis ROOT binding
- Geant4 integration prototype (limited U.S. involvement)

In addition, the following are desirable:
- Particle properties service deployed
- Statistics and monitoring tools prototype
- Bookkeeping prototype

WBS 2.2.1.2

Summer, 2001: Selection of database technology

Still a 'floating' milestone in International ATLAS, without a firm date. Will almost certainly be delayed. Mid 2002 is under discussion. This will allow time to properly evaluate both the current baseline (Objectivity) and other possible solutions (Oracle 9i, ROOT). The U.S. will be (must be) a strong contributor to the prototyping, evaluating, and decision making involved, and this will be a focus area in the database and data management effort in the coming months.

5. WBS 2.3 US ATLAS Facility Manager's Report (B. Gibbard, R. Baker, BNL)

Introduction

The plan of work presented in November, 2000 for the Brookhaven Tier 1 facility was based on funding of $1,411K, but the actual funding received was only $575K. Due to this significant budget reduction, we were forced to reprioritize the planned work. The highest priority was given to continued support of the US ATLAS user community. No significant expansion of the existing facility was possible, so new hardware acquisitions were targeted to provide resources essential for the growing user community. No additional staff was hired, and the existing staff was sufficient only for continued support of the existing facility. A prototype Tier 1 Grid node was established at BNL, and the two prototyped Tier 2 centers were designated to be Indiana University and Boston University.

WBS 2.3.1 Tier 1 Computing Facility at Brookhaven National Laboratory

WBS 2.3.1.1 Hardware

The significant milestones for hardware acquisitions in FY'01 were establishing 1% prototypes of both the online (disk) storage system and the offline (tape) storage system. The CPU system had already been established at a 1.5% level during FY'00 and no upgrade was planned for FY'01. Because of reduced funding, the disk storage was expanded only modestly to accommodate the immediate needs of the US ATLAS user community. The available disk storage is currently 700 GB, 0.2% of full scale. The tape storage system was not augmented during the quarter. In addition to the upgrade of the disk storage system, there were some associated upgrades to the local area network.

The planned level of effort for WBS 2.3.1.1 was 1.1 FTE, but during the quarter, the actual effort was only 0.6 FTE. The reduced effort did not allow any new prototyping efforts because the available manpower was entirely consumed by supporting the existing facility.

WBS 2.3.1.2 Tier 1 Facility Software

During the quarter, there were no significant changes to the software configuration at the Tier 1 facility. Work in this area consisted entirely of continued support of existing software.

The planned level of effort for WBS 2.3.1.2 was 1.6 FTE, of which 1.0 FTE was planned for upgrading the HPSS system. The actual level of effort was 0.3 FTE. The reduced effort forced us to delay our plans for the HPSS upgrade and did not allow us to explore any new software choices for the Tier 1 facility.

WBS 2.3.1.3 Tier 1 Facility Administration and Support

During the quarter, the two US ATLAS prototype Tier 2 centers were designated to be Indiana University and Boston University. The selection process was organized by the Tier 1 facility managers.

The planned level of effort for WBS 2.3.1.3 was 1.7 FTE, but the actual level of effort was only 1.0 FTE. The reduced staffing did not allow any progress on new facility monitoring tools, and user support was limited.

WBS 2.3.2 Distributed IT Infrastructure

Tier 1 Work:

During the quarter, we demonstrated the ability to exchange authentication credentials with our European collaborators. Globus requests from Italy were successfully executed at BNL.

The Tier 1 site at BNL has deployed a dedicated Linux farm (currently two nodes, but expandable to meet demand) that is available to serve requests from other US ATLAS Grid sites

via LSF queue. The Tier 1 disk storage resources are available for Grid data transfers. We have been actively working on enabling Grid access to the Tier 1 HPSS storage and we expect significant progress during the next quarter.

The planned level of effort for Tier 1 staff under WBS 2.3.2 was 1.1 FTE, but the actual level of effort was 0.6 FTE. The reduced staffing limited our ability to make progress in this area, but we did accomplish our primary goal of establishing an initial prototype Tier 1 Grid node at BNL.

6. Financial Report (Robert Ernst, BNL)

FINANCIAL SUMMARY

The total of funding for the US ATLAS Computing Project for Fiscal Year's 2000 and 2001 is expected to reach $4,375,000 dollars during Fiscal Year 2001. The Project is supported by two funding agencies.

DOE program funding includes allocations from Fiscal Year 2000 through 2001, in the amount of $2,626,000. An additional $500,000 of funding was issued to collaborators during the second quarter of Fiscal Year 2001.

NSF funding is based on:

- Contracts issued under an existing NSF Grant for LHC Computing ($1,600,000) with Columbia University. The grant award period extends through Fiscal Year 2002. The overall US ATLAS Computing Project's anticipated share of the grant is $970,000 of which $839,000 has been allocated in contracts to date. An additional $210,000 of funding was issued to collaborators during the second quarter of Fiscal Year 2001. There is also a pending Supplemental Request to the Columbia Grant for an additional allocation of $660,000 during Fiscal Year 2001.

- NSF Grant with University of Chicago ($250,000) to support US ATLAS Computing efforts.

Appendix Table 1: The details of the reported costs and reported obligations

Appendix Table 2: Summary of Agency Funding Profile

Appendix Table 3: Summary of Allocation of Funding to Institutions

Table 1

U.S. ATLAS Computing Project
Summary of Funds Authorized
and
Total Costs and Commitments to Date
March 31, 2001
(AY$ x 1,000)

WBS No.	Description	Funds Authorized Thru FY01	Expenses + Commitments: Expenses to Date	Expenses + Commitments: Open Commit	Expenses + Commitments: Total to Date	Balance of Authorized Funds
2.1	Physics	-	-	-	-	-
2.2	Software Projects	3,278	1,620	20	1,640	1,638
2.3	Computing Facilities	515	259	16	275	240
2.9	Project Support *	53	53	-	53	-
	Subtotal	3,846	1,932	36	1,968	1,878
	Anticipated NSF Additional Funds	660	-	-	-	660
	Anticipated DOE Additional Funds	-	-	-	-	-
2	U.S. ATLAS Computing Total AY$	4,506	1,932	36	1,968	2,538

* Columbia University\Nevis Contract administration expenses

Table 2

	Agency Funding Profile (k$)			
Agency	FY 00	FY 01	Total	
DOE	1126	1500	2626	
NSF	655	1094	1749	**
Total	1781	2594	4375	

** Includes $660k in NSF Supplemental Grant Request for Columbia University in FY 01

Table 3

US ATLAS Computing Project

Funding Distribution Table

31-Mar-01

	FY00			FY01		Cum Thru FY01 U.S. ATLAS Computing			
Institution	DOE	NSF	Total	DOE	NSF	DOE	NSF r&d	NSF	Total
ANL	230		230	540		770		-	770
BNL			-			-		-	-
Software Projects	194		194	125		319		-	319
Computing Facilities	320		320	195		515		-	515
Project Support			-			-		-	-
LBNL/UCB	382	178	560	640	210	1,022		388	1,410
Boston University			-			-		-	-
U of Chicago		250	250			-		250	250
Harvard University			-			-		-	-
Indiana University			-			-		-	-
Nevis/Columbia			-			-		-	-
Software Projects		149	149		224	-		373	373
Project Support		53	53			-		53	53
U of Michigan		25	25			-		25	25
Pending			-	0	660	-		660	660
Total FY	1,126	655	1,781	1,500	1,094	2,626	-	1,749	4,375